FINAL REPORT ON NASA GRANT NO. NAG5-4273:

SEPARATING SPATIAL AND TEMPORAL VARIATIONS OF THE AURORA USING TWO NEARLY COLOCATED SATELLITES

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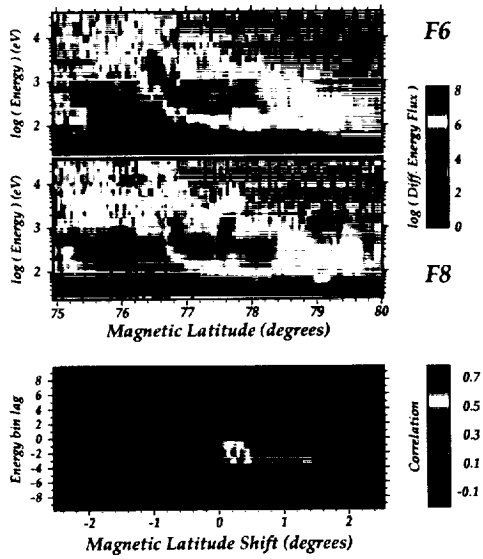

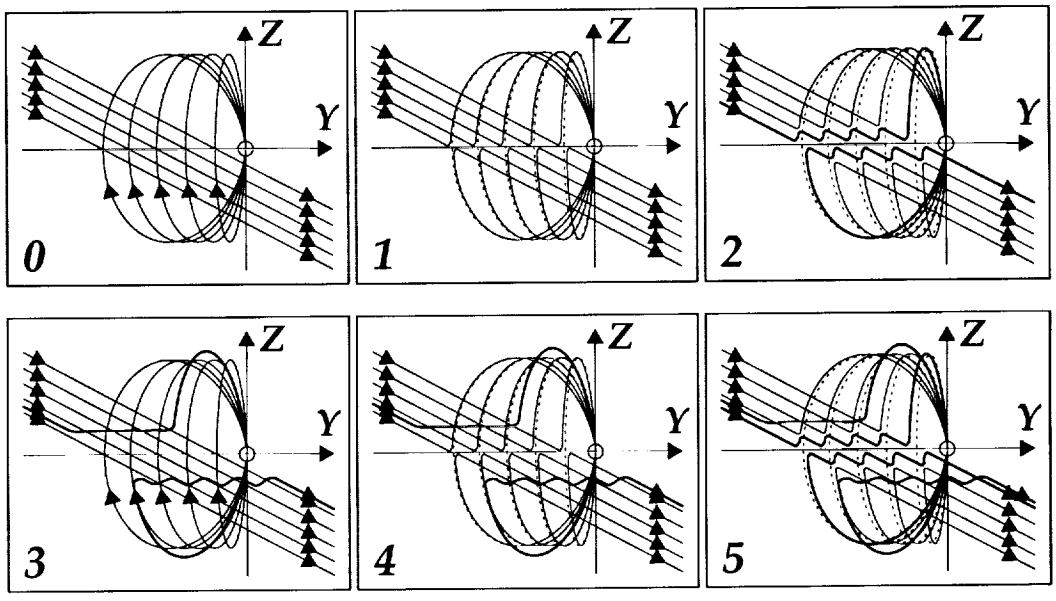

Bursty Multiple X-line Reconnection model developed to explain unique, time-evolving and spatially separated overlapping cusp precipitation signatures measured by the dual-DMSP spacecraft.

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Period of Performance: 5/1/97-4/30/01

Final Report Summary of Research

This final report describes the efforts accomplished during the grant's period of performance, covering the period of 1 May 1997 to 30 April 2001, of a NASA Supporting Research and Technology Program grant under the Ionospheric, Thermospheric, and Mesospheric Physics component of the Sun-Earth Connections program. We have met and exceeded the goals set forth in the proposed research objectives. Refereed publications have appeared in the scientific literature and several others are in the review process. In addition, numerous invited and contributed presentations of these studies were presented at national and international meetings during the performance period. One graduate student completed his PhD and won two AGU Best Student Paper awards based on research funded by this grant. These studies are summarized below.

The science goal delineated in the initial proposal was "to systematically explore the temporal and spatial characteristics of the aurora in a way heretofore impossible, using data from two coplanar DMSP spacecraft." We accomplished this goal through a series of related studies. One study used these unique data to establish the role of Ps6 waves in coupling between the magnetosphere and the auroral ionosphere (omega bands) during the recovery phase of a magnetic storm; the published paper demonstrated the causal relationships between geospace processes occurring in different regions and established a simple conceptual model based on the fortuitous constellation of observations.

In the second string of papers, we used these data to explore velocity-dispersed ions (VDIS) in and near the cusp, to test region identification models, and to look at space/time structure of auroral preciptiation. On the first topic, the unique DMSP data revealed a remarkable double VDIS with a latitudinal overlap. This could only be explained in terms of a unified reconnection geometry that builds on several earlier unrelated models. The paper outlining this discovery has drawn considerable attention from the community and is currently in press – it adds significantly to the debate over whether reconnection is study state versus bursty and patchy versus global.

The second paper develops the model further by incorporating the electron signature – these ionospheric particle precipitation signatures reveal the presence of magnetospheric "fossilized" FTEs, demonstrating the power of ionospheric measurements as a remote diagnostic of magnetospheric processes. Finally, the general nature of auroral stability and coherence and region identifiction by particle characteristics were fully explored in a final paper. We identify candidate mechanisms controlling coherence time scales and length scales and refine boundary region identification criteria. We also use the dual-DMSP observations to identify the open and closed LLBL region and related its significance to the generalized bursty, multiple x-line model developed in the first paper. All of these topics are chapters of Dr. Boudouridis' recently completed PhD thesis.

Student Involvement

Two graduate students were supported over the lifetime of the grant, one only partially (Anders Jorgensen) and the other fully (Athanasios Boudouridis). Dr. Boudouridis' PhD dissertation was based solely on the research supported by this grant. His last two presentations as a student at AGU meetings resulted in Best Student Paper awards.

List of Inventions

No inventions were developed as a result of this research effort for the entire performance period covered in this report.

Publications (Italicized authors are BU Graduate Students)

1. *Jorgensen, A. M.*, H. E. Spence, T. J. Hughes, and D. McDiarmid, A study of omega bands and Ps-6 pulsations on the ground, at low-altitude, and at geostationary orbit, J. Geophys. Res, 104, 14705, 1999.

2. *Boudouridis, A.*, H. E. Spence, and T. G. Onsager, A new look at the pulsed reconnection model of the dayside magnetopause, Adv. Space Res., accepted, 2001.

3. *Boudouridis, A.*, H. E. Spence, and T. G. Onsager, Investigation of magnetopause reconnection models using two co-located, low-altitude satellites: A unifying reconnection geometry, J. Geophys. Res., accepted, 2001.

4. *Boudouridis, A.*, "Spatial and temporal aspects of high-latitude particle precipitation: a remote diagnostic of magnetospheric processes", *PhD Dissertation*, 23 March 2001.

5. *Boudouridis, A.*, and H. E. Spence, Formation of the LLBL in the Context of a Unifying Magnetopause Reconnection Mechanism, *AGU Monograph for LLBL Chapman Conference*, submitted, July 2001.

6. *Boudouridis, A.*, and H. E. Spence, Separation of spatial and temporal structure of auroral particle precipitation, *J. Geophys. Res.*, to be submitted, August 2001.